

GATE -2021 SYLLABUS: - CIVIL ENGINEERING

Section - 1

Engineering Mathematics

Linear Algebra: Matrix algebra; Systems of linear equations; Eigen values and Eigen vectors.

Calculus: Functions of single variable; Limit, continuity and differentiability; Mean value theorems, local maxima and minima; Taylor series; Evaluation of definite and indefinite integrals, application of definite integral to obtain area and volume; Partial derivatives; Total derivative; Gradient, Divergence and Curl, Vector identities; Directional derivatives; Line, Surface and Volume integrals.

Ordinary Differential Equation (ODE): First order (linear and non-linear) equations; higher order linear equations with constant coefficients; Euler-Cauchy equations; initial and boundary value problems.

Partial Differential Equation (PDE): Fourier series; separation of variables; solutions of one-dimensional diffusion equation; first and second order one-dimensional wave equation and two-dimensional Laplace equation.

Probability and Statistics: Sampling theorems; Conditional probability; Descriptive statistics – Mean, median, mode and standard deviation; Random Variables – Discrete and Continuous, Poisson and Normal Distribution; Linear regression.

Numerical Methods: Error analysis, Numerical solutions of linear and non-linear algebraic equations; Newton's and Lagrange polynomials; numerical differentiation; Integration by trapezoidal and Simpson's rule; Single and multi-step methods for first order differential equations.

Section - 2

Structural Engineering

Engineering Mechanics: System of forces, free-body diagrams, equilibrium equations; Internal forces in structures; Frictions and its applications; Centre of mass; Free Vibrations of undamped SDOF system.

Solid Mechanics: Bending moment and shear force in statically determinate beams; Simple stress and strain relationships; simple bending theory, flexural and shear stresses, shear centre; Uniform torsion, Transformation of stress; buckling of column, combined and direct bending stresses.

Structural Analysis: Statically determinate and indeterminate structures by force/energy methods; Method of superposition; Analysis of trusses, arches, beams, cables and frames;

Displacement methods: Slope deflection and moment distribution methods; Influence lines; Stiffness and flexibility methods of structural analysis.

Construction Materials and Management: Construction Materials: Structural Steel– Composition, material properties and behavior; Concrete - Constituents, mix design, short- term and long-term properties. Construction Management: Types of construction projects; Project planning and network analysis - PERT and CPM; Cost estimation.

Concrete Structures: Working stress and Limit state design concepts; Design of beams, slabs, columns; Bond and development length; Pre stressed concrete beams.

Steel Structures: Working stress and Limit state design concepts; Design of tension and compression members, beams and beam- columns, column bases; Connections–simple and eccentric, beam-column connections, plate girders and trusses; Concept of plastic analysis - beams and frames.

Section - 3

Geotechnical Engineering

Soil Mechanics: Three-phase system and phase relationships, index properties; Unified and Indian standard soil classification system; Permeability - one dimensional flow, Seepage through soils – two - dimensional flow, flow nets, uplift pressure, piping, capillarity, seepage force; Principle of effective stress and quicksand condition; Compaction of soils; One- dimensional consolidation, time rate of consolidation; Shear Strength, Mohr's circle, effective and total shear strength parameters, Stress-Strain characteristics of clays and sand; Stress paths.

Foundation Engineering: Sub-surface investigations - Drilling bore holes, sampling, plate load test, standard penetration and cone penetration tests; Earth pressure theories - Rankine and Coulomb; Stability of slopes – Finite and infinite slopes, Bishop's method; Stress distribution in

soils –Boussinesq’s theory; Pressure bulbs, Shallow foundations –Terzaghi’s and Meyerhoff’s bearing capacity theories, effect of water table; Combined footing and raft foundation; Contact pressure; Settlement analysis in sands and clays; Deep foundations –dynamic and static formulae, Axial load capacity of piles in sands and clays, pile load test, pile under lateral loading, pile group efficiency, negative skin friction.

Section -4

Water Resources Engineering

Fluid Mechanics: Properties of fluids, fluid statics; Continuity, momentum and energy equations and their applications; Potential flow, Laminar and turbulent flow; Flow in pipes, pipe networks; Concept of boundary layer and its growth; Concept of lift and drag.

Hydraulics: Forces on immersed bodies; Flow measurement in channels and pipes; Dimensional analysis and hydraulic similitude; Channel Hydraulics - Energy-depth relationships, specific energy, critical flow, hydraulic jump, uniform flow, gradually varied flow and water surface profiles.

Hydrology: Hydrologic cycle, precipitation, evaporation, evapo-transpiration, watershed, infiltration, unit hydrographs, hydrograph analysis, reservoir capacity, flood estimation and routing, surface run-off models, ground water hydrology - steady state well hydraulics and aquifers; Application of Darcy’s Law.

Irrigation: Types of irrigation systems and methods; Crop water requirements - Duty, delta, evapo- transpiration; Gravity Dams and Spillways; Lined and unlined canals, Design of weirs on permeable foundation; cross drainage structures.

Section – 5

Environmental Engineering

Water and Waste Water Quality and Treatment: Basics of water quality standards – Physical, chemical and biological parameters; Water quality index; Unit processes and operations; Water requirement; Water distribution system; Drinking water treatment. Sewerage system design; quantity of domestic wastewater; primary and secondary treatment. Effluent discharge \ standards; Sludge disposal; Reuse of treated sewage for different applications.

Air Pollution: Types of pollutants, their sources and impacts, air pollution control, air\ Quality standards; Air quality Index and limits.

Municipal Solid Wastes: Characteristics, generation, collection and transportation of solid wastes, engineered systems for solid waste management (reuse/ recycle; energy recovery, treatment and disposal).

Section – 6

Transportation Engineering

Transportation Infrastructure: Geometric design of highways - cross-sectional elements, sight distances, horizontal and vertical alignments. Geometric design of railway Track – Speed and Cant. Concept of airport runway length, calculations and corrections; taxiway and exit taxiway design.

Highway Pavements: Highway materials - desirable properties and tests; Desirable properties of bituminous paving mixes; Design factors for flexible and rigid pavements; Design of flexible and rigid pavement using IRC codes.

Traffic Engineering: Traffic studies on flow and speed, peak hour factor, accident study, statistical analysis of traffic data; Microscopic and macroscopic parameters of traffic flow, fundamental relationships; Traffic signs; Signal design by Webster’s method; Types of intersections; Highway capacity.

Section – 7

Geomatics Engineering

Principles of surveying; Errors and their adjustment; Maps - scale, coordinate system; Distance and angle measurement - Leveling and trigonometric leveling; Traversing and triangulation survey; Total station; Horizontal and vertical curves.

Photogrammetry and Remote Sensing - Scale, flying height; Basics of remote sensing and GIS

Changes in GATE-2021 syllabus from GATE-2020 syllabus for CIVIL ENGINEERING (TECHNICAL SUBJECTS)

Subjects	Added new Topics	Removed topics
Engineering Mechanics	<ul style="list-style-type: none"> • Internal forces in structures • Centre of mass • Free vibrations of undamped SDOF system 	<ul style="list-style-type: none"> • Dynamics
Strength of Materials	<ul style="list-style-type: none"> • Stress Transformation 	<ul style="list-style-type: none"> • Theory of Failures
Construction Materials	NA	<ul style="list-style-type: none"> • Bricks, Mortar & Timber
Geotechnical Engineering	<ul style="list-style-type: none"> • Pile under laterally loading 	<ul style="list-style-type: none"> • Origin of soil, Soil structure & Fabric • Westergaards theory
Fluid Mechanic	NA	<ul style="list-style-type: none"> • Hydraulic Machines
Hydrology	<ul style="list-style-type: none"> • Reservoir Capacity • Watershed 	NA
Environmental Engg	<ul style="list-style-type: none"> • Water Quality Index • Air Quality Index • Re-use & Recycling of Waste Water 	<ul style="list-style-type: none"> • Noise Pollution
Transportation Engineering	<ul style="list-style-type: none"> • Traffic Signs 	<ul style="list-style-type: none"> • Highway alignment and engineering surveys • Quality Control • Distresses in concrete pavements • Travel time - delay and O-D study, PCU • Parking study • Control devices • Types of Channelization • Level of service of rural highways and urban roads